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AUG 1961

British

# 874,229

Aug 3 1961

874229 COMPLETE SPECIFICATION  
1 SHEET  
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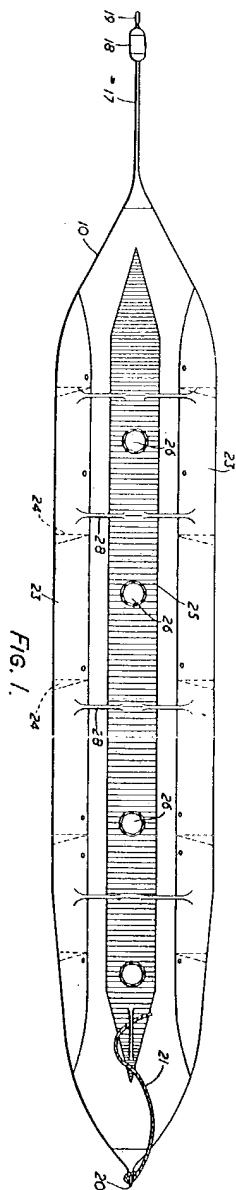


FIG. 1.

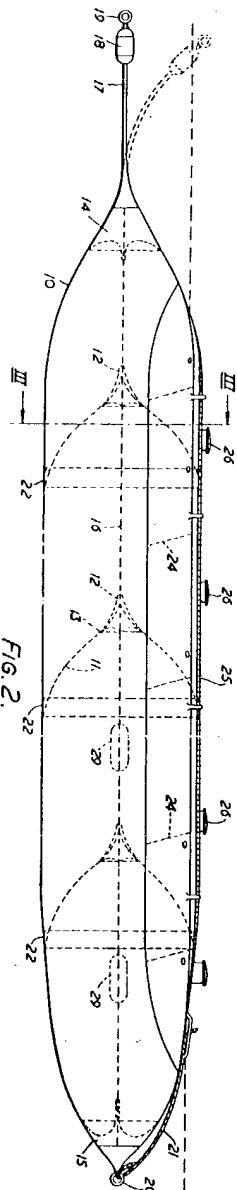


FIG. 2.

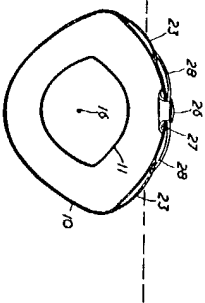


FIG. 3.



FIG. 4.

# PATENT SPECIFICATION

DRAWINGS ATTACHED



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No. 119/57.

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International Classification:—B63b.

## COMPLETE SPECIFICATION

### Flexible Barges for Liquid or Semi-liquid Cargoes

We, HENRY NORTON, HUBERT VEARE NORTON, LESLIE BUCKINGHAM NORTON, and DOUGLAS EDWIN NORTON, all British Subjects and all of "Bancroft", Plough Road, Smallfield, Horley, Surrey, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to flexible barges for liquid or semi-liquid cargoes.

It has been proposed to transport liquid or semi-liquid cargoes such as oil in flexible sausage-shaped barges which are towed behind a tug or other vessel either singly or in groups. The flexibility of the skin of the barge permits the barge to bend and follow to some extent the wave motion of the water in which it floats, permits the hydrostatic forces to be transmitted freely from the cargo to the surrounding water whereby the skin of the barge itself is to a large extent relieved of such forces, and permits the barge to vary its cross-sectional shape and area in order to relieve stress and pressure concentrations brought about by longitudinal loads, shock waves and the like, any particular section of the skin deforming itself as necessary to suit the buoyancy and loading characteristics at that section.

A flexible barge according to the present invention comprises a flexible sausage-shaped skin, a cable extending longitudinally through the barge and, at intervals along the length of the barge, flexible bulkheads attached to this cable and to the skin.

The longitudinal forces resulting from the motion of the barge through the water and the frictional drag on the skin are thus distributed from the skin to the cable at several places along the length of the barge, thereby partially relieving the skin from these longitudinal forces. The bulkheads, which serve to transmit these forces between the skin and

the cable at intervals along the length of the barge, also serve to divide the interior of the barge into several separate compartments.

In one form of the invention the barge is without its own motive power and is arranged so that it can be towed, the towing force being applied to the cable. In such barges, particularly in large sizes, a rigid or semi-rigid nose may be provided. In another form of the invention the barge is self-propelled, the propulsion unit being mounted, for instance, in a rigid or semi-rigid nose.

The outer skin, being flexible, deforms in shape and varies its cross-sectional area depending upon the degree to which the barge is filled, and in dependence upon the external and internal loadings to which it is subjected.

Preferably, the said bulkheads are of dome-like or conical form, so that they will conform more readily to changes in the cross-sectional size and shape of the skin. If a bulkhead is mounted with its convex side facing forwardly it is better able to transmit the towing force from the cable to the skin, but it may be necessary in certain cases to reverse one or more bulkheads to enable the towing force to pressurise the adjacent forward compartment.

Preferably, the upper parts of the barge are provided with buoyancy chambers, conveniently in the form of longitudinal inflatable blisters. By providing such blisters on each side of the barge above the horizontal centre line, stability of the barge against rolling is improved. These or other buoyancy chambers may be provided to afford additional buoyancy when the barge is to carry a liquid of about the same density as water, or denser.

The barge may be provided with hatchways, ports and the like to afford access to its interior for filling, emptying and inspection, and where such hatchways or ports

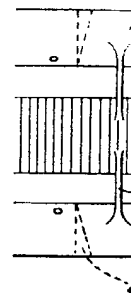


FIG. 1.

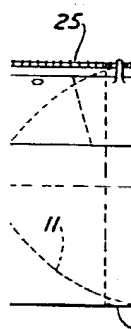


FIG. 2.

are provided it is desirable to provide additional buoyancy chambers in the vicinity of these parts, in order to prevent these parts from sinking into the cargo in the respective compartments and allowing the cargo to spill over.

A flexible deck or catwalk may be provided along the top of the barge.

Preferably, the connections between the cable and the bulkheads, and between the cable and the one or two flexible ends of the skin, are effected by means of rigid conical or dome-like members which are attached to the cable at the centre and which are joined around their edges to the material of the bulkhead or the skin, as the case may be, the angle of the margin of each dome-like member being approximately equal to the natural angle of the bulkhead or skin at this point.

The material of the skin and, if desired, of the bulkheads as well, is conveniently a flexible reinforced plastic material. Preferably the reinforcement is as described in the present Applicants' co-pending British Patent Application No. 120 of 1957 (Serial No. 872,027).

The invention may be performed in various ways and one particular embodiment will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a plan view of a towable barge embodying the invention;

Figure 2 is a side elevation;

Figure 3 is a cross-section taken on the line III—III in Figure 2; and

Figure 4 is a cross-section of the barge when empty.

The barge shown in the drawings comprises a sausage-shaped flexible skin 10 made of reinforced plastic material, the reinforcement being as described in the present Applicants' co-pending British Patent Application No. 120 of 1957 (Serial No. 872,027). Disposed at intervals along the length of the barge are dome-like flexible bulkheads 11 which are attached around their edges to the skin 10 in the zones 22 and which divide the barge into several separate compartments. The bulkheads 11 as shown are arranged with their convex surfaces towards the front of the barge, but in certain cases one or more bulkheads may be reversed. The centres of the bulkheads are provided with rigid conical members 12, these members being joined around their edges to the material of the bulkheads 11, the angle of the margin of each member 12 being approximately equal to the natural angle of the bulkhead at this point, as shown at 13 in Figure 2. Similar members 14 and 15 are provided at the front and rear of the barge respectively.

Extending longitudinally throughout the

length of the barge is a central cable 16 which is attached to the members 12, 14 and 15. At the front of the barge the cable 16 is provided with an external extension 17 equipped with a pick-up buoy 18 and a towing eye 19. A mooring eye 20 is provided at the rear of the barge and is fitted with a painter 21.

The arrangement of the cable 16 and its connection to the parts 12, 14 and 15 is such that the towing force imparted to the cable through the towing eye 19 and the extension 17 is transmitted to the skin 10 by the member 14 and to the bulkheads 11 by the members 12, the bulkheads 11 in turn transmitting the force to the skin 10 in the zones 22.

Along the upper part of the barge, on each side above the centre line, there is provided a buoyancy blister 23, these blisters being provided with internal bulkheads 24.

Along the top of the barge is a catwalk 25, and projecting at intervals through the catwalk are hatchways or ports 26 each giving access to one of the compartments in the barge. To provide additional buoyancy for these hatchways to ensure that they do not sink into the liquid cargo in the respective compartments, ring-shaped buoyancy chambers 27 are provided in the top of the barge round each of the hatchways 26.

Mooring and handling attachments 28 are provided at intervals, extending from the buoyancy blisters 23 to the catwalk 25.

The cable may be provided at intervals with buoyant fend-offs 29 to prevent chafing of the skin 10 should the cable sag.

The flexible outer skin of the barge takes up a shape and cross-section which depends upon the extent to which the barge is filled and upon the external and internal loadings to which the skin is subjected. For instance, when the barge is floating in the filled condition its cross-section will be as shown in Figure 3. On the other hand, when the barge is empty, its cross-section will be as shown in Figure 4.

#### WHAT WE CLAIM IS:—

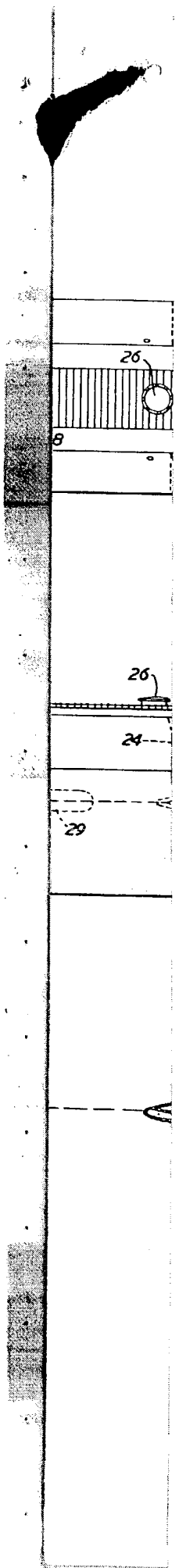
1. A flexible barge comprising a flexible sausage-shaped skin, a cable extending longitudinally through the barge, and, at intervals along the length of the barge, flexible bulkheads attached to this cable and to the skin.

2. A flexible barge as claimed in Claim 1 in which the bulkheads are of dome-like or conical form.

3. A flexible barge as claimed in Claim 1 or Claim 2 the upper parts of which are provided with buoyancy chambers.

4. A flexible barge as claimed in Claim 3 in which the buoyancy chambers comprise longitudinal inflatable blisters, one on each side of the barge above the horizontal centre line.

5. A flexible barge as claimed in any of



the preceding claims provided with hatchways or ports and buoyancy chambers in the vicinity of these parts.

- 5 6. A flexible barge as claimed in any of the preceding claims in which the connections between the cable and the bulkheads, and between the cable and at least one flexible end of the skin, are effected by means of rigid conical or dome-like members which  
10 are attached to the cable at the centre and which are joined around their edges to the material of the bulkhead or the skin, as the case may be, the angle of the margin of each dome-like member being approximately

equal to the natural angle of the bulkhead or skin at this point. 15

7. A flexible barge as claimed in any of the preceding claims in which the material of the skin is a flexible reinforced plastic material, the reinforcement being as described and claimed in the present Applicants' co-  
20 pending British Patent Application No. 120 of 1957, Serial No. 872,027.

8. A flexible barge substantially as described with reference to the accompanying  
25 drawings.

KILBURN & STRODE,  
Agents for the Applicants.

#### PROVISIONAL SPECIFICATION

#### Flexible Barges for Liquid or Semi-liquid Cargoes

We, HENRY NORTON, HUBERT VEARE NORTON, LESLIE BUCKINGHAM NORTON, and DOUGLAS EDWIN NORTON, all British Subjects  
30 and all of "Bancroft", Plough Road, Smallfield, Horley, Surrey, do hereby declare this invention to be described in the following statement:—

This invention relates to a method of transport by sea of large quantities of liquid or semi-liquid cargoes, in a manner whereby the structure of the craft is flexible enabling the container or craft to adapt itself to variations in water level so that the cargo  
35 may support or partially support itself by virtue of its own relative displacement, as opposed to more conventional means of ship construction. A craft that may be towed or self powered, and possessing unique features,  
40 suitable for both War and Peace time purposes. According to the said invention for which we will describe one aspect, the container or craft would comprise a cylindrically shaped outer skin of a reinforced flexible plastic or composite material having a length  
45 in the region of 10 times its own diameter, terminating in tapered ends.

Passing centrally through the entire length of the craft, and attached to the end sections by means of collector rings is a cable sufficient  
50 in strength to carry the driving or towing strain of the container.

The collector rings themselves are a fabricated funnel, shaped to the same angle as the ends of the container. The cable is fixed centrally to the collector rings by means of collets or similar type fixing and the reinforcing and or outer skin is anchored firmly to the periphery of the collector ring, thus  
65

transferring the motive power to the entire outside skin. 70

Conical shaped bulk heads are situated internally at convenient intervals, and are made integral with the outer skin and in turn are anchored to additional collector rings  
75 at suitable positions on the central cable.

The tapered shape of the ends and conical shape of the bulk heads enable great variation in cross section of the outer skin without imposing undue compression or tension on the bulk heads or craft. Hatchways, pipe fittings, valves and the like, are fixed in a similar method to the collector rings. 80

Affixed to either side are stabilizing blisters manufactured from the same material and running the entire length of the container or craft. The blisters or ribs when filled with air represent together less than 1/10th of the total capacity of the craft and serve to maintain an even keel when the container is full. When carrying crude oil it may be desirable for the complete craft to slowly rotate to prevent the settlement of wax and the like, in such circumstances the craft may be fitted with a spiral keel or fin, running in a helix round the outer skin, thus generating its own rotary motion while under power. 85 90 95

To prevent sagging and chaffing of the inner cable on the bulk heads or outer skin the inner cable is encased with a buoyant fendoff at strategic points. 100

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